The above comparisons indicate that the electrode of our invention has high electro-chemical efficiency. The potentials observed by using our electrode have been found reproducible to a high degree as shown by the results indicated in the above tables. The largest errors are obtained when using a H-synthetic cation exchanger composition membrane (H4, H5, H6) for measuring potentials in the NaCl solution. Substantially higher accuracy is obtained when the type of synthetic cation exchanger used in the membrane corresponds to the ion in solution. Furthermore, the potentials observed using our electrode agree substantially with those computed and also with those measured with a glass electrode for the simple case of pH measurement. The tables indicate that reproducibility of better than 2 per cent in potential is obtainable using the electrode of our invention and that the measured potential is independent to within this accuracy of variations in membrane thickness, variations in membrane resistance and variations in percentage composition.

The E. M. F.'s measured with electrodes of our invention employing polystyrene as the plastic have been compared with those computed by the well-known Nernst equation, the activities of the sodium ions being computed from the known mean activities of sodium chloride solutions at the appropriate concentrations on the assumption that the activities of the chloride ions are the same as that of the chloride ion in solutions of potassium chloride of the same ionic strength as the sodium chloride solutions. It is further assumed that the activities of the potassium and chloride ions in potassium chloride solutions are equal and are thus calculable from the known mean activities of the appropriate potassium chloride solutions. It was found that the observed potentials follow closely those predicted by this equation. The accompanying Tables V and VI show the results of such a comparison with theoretically computed emf's. The physical characteristics of the particular electrodes used are given in Table IV. The sodium ion exchange resin referred to in Tables IV, V, and VI was the sodium form of a sulfonated phenolic formaldehyde resin.

TABLE IV

Physical characteristics of some electrodes made from bonded Na-exchange resin ground to less than 200 mesh and polystyrene resin membranes separating NaCl solutions

Electrode Number	Composition of Membrane, Weight Percentages of Na-Exchange resin	Thickness of Membrane (mm.)	Total Resistance of Membrane, ohms
A	50	0.5	1,200,000
B	60	1.1	230,000
C	60	1.2	220,000
D	70	1.3	3,600
E	70	1.6	6,000
F	70	4.2	1,340
G	70	1.8	5,600

An accuracy of better than 3 per cent in potential is indicated when compared with theoretical computations. However, the tables show an even higher degree of reproducibility and it is the latter criterion which is of practical importance.

The tables also show that electrode resistance may vary over a wide range with sub-

TABLE V

Potentials obtained at 22° C. with bonded Na-exchange resin and polystyrene resin membranes separating NaCl solution

Electrode Number	4.000 m. NaCl and 0.700 m. NaCl		2.000 m. NaCl and 0.250 m. NaCl	
	Mean E. M. F. Observed (±0.1 m. v.) (m. v.)	Theoretical E. M. F. (m. v.)	Mean E. M. F. Observed (±0.1 m. v.) (m. v.)	Theoretical E. M. F. (m. v.)
A	51.8	54.8	53.7	53.1
B	51.7	54.8	53.7	53.1
C	52.4	54.8	53.8	53.1
D	53.2	54.8	53.3	53.1
E	53.0	54.8	54.0	53.1
F	53.3	54.8	53.3	53.1
G	53.5	54.8	55.0	53.1

TABLE VI

Potentials obtained at 22° C. with bonded Na-exchange resin and polystyrene resin membranes separating NaCl solutions

Electrode Number	1.000 m. NaCl and 0.107 m. NaCl		0.100 m. NaCl and 0.010 m. NaCl	
	Mean E. M. F. Observed (±0.1 m. v.) (m. v.)	Theoretical E. M. F. (m. v.)	Mean E. M. F. Observed (m. v.)	Theoretical E. M. F. (m. v.)
A	59.2	58.2	54.5	55.0
B	58.8	58.2	55.5	55.0
C	59.3	58.2	56.0	55.0
D	58.5	58.2	55.8	55.0
E	58.9	58.2	55.6	55.0
F	59.0	58.2	55.1	55.0
G	60.3	58.2	55.2	55.0

stantially no effect on the potentials measured with our electrode. Furthermore, the tables show that variations in membrane thickness are of substantially no influence on the measured E. M. F.'s and also that limited variations in composition have substantially no influence on the measured E. M. F.'s.

As previously pointed out, the electrode membrane as constructed according to our invention may be made with relatively low electrical resistance (as illustrated by the electrode designated in the tables as D, E, F, G), thus permitting rapid measurements to be made with an ordinary potentiometer and without the use of an electronic amplifier.

This application is a continuation of our copending, co-assigned application Serial No. 75,924, filed February 11, 1949, entitled Electrode for determining cationic activity (now abandoned) and of our copending, co-assigned application Serial No. 95,814, filed May 27, 1949, entitled Electrode for determining cationic activity (now abandoned).

What we claim as our invention is:

1. A method of making an electrode which comprises preparing a composition by intimately mixing a finely-divided cationic-exchange material with a chemically-inert electrically-insulating moldable bonding resin, molding said composition so as to form at least a part of the wall of a container, placing inside said container and in contact with said composition an electrolyte of desired cationic activity, and immersing an electrical connecting element in said contained electrolyte.